Ozone Profile Information and Validation for OMI, MLS and SBUV/2

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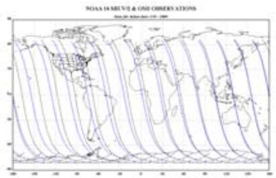
Introduction

Excellent match-up and zonal mean comparisons are available between ozone products from the NOAA-16, -17 and -18 POES SBUV/2 and the EOS Aura instruments. This poster reports on a variety of intercomparisons among the products and measurements. The NOAA-16 and NOAA-17 SBUV/2 ozone profile retrievals are compared to the MLS retrievals. The SBUV/2 measurements are compared to OMI measurements through a retrieval/forward model combination. The stability of the different instrument measurement systems over orbits, days and months are examined. Relative biases and variability are characterized as functions of height and latitude.



OMI – Green   NOAA-16 SBUV/2 - Blue

Ozone Profiles Comparisons

MLS ozone profiles are converted from PPMV to ozone layer amounts. The layer amounts are preferable in this study so that the profiles may be run through TOMRAD. The layer pressures are the same as used in V8SBUV (21 layers). The MLS data are screened for precision, quality, and status flags. The pressures compared lie within the range of 251 hPa to 0.1 hPa. Match-ups were found within a 40 day time period going from June 1 to July 10 2005. The match-up criteria were: geographical distances less than 50 km (less than 20 km at very high latitudes) and measurement time differences less than 1.5 hours. Only NOAA-16 SBUV/2 V8 profiles are used in the results shown here. (NOAA-17 and NOAA-18 to follow in later studies.) Figure 1 shows the bias and standard deviations of the differences in the match-ups over broad latitude bands.

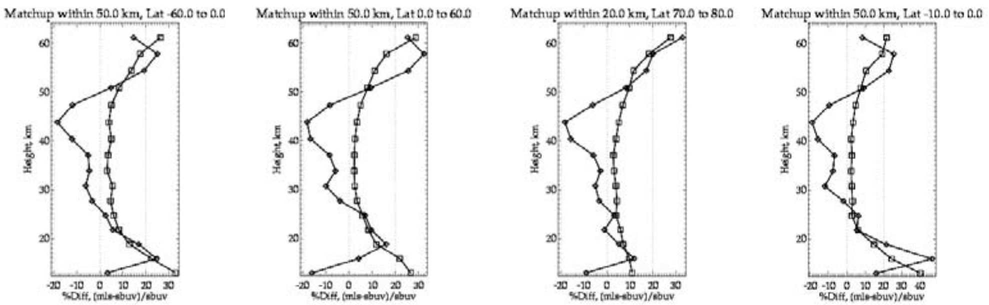


Figure 1. Profile differences for EOS Aura MLS & NOAA-16 SBUV/2 Match-up Ozone Profiles.

Zonal means for broad pressure layers were computed for the MLS and SBUV/2 ozone profile retrievals in DU. The results for Jan 1, 2005, comparing MLS to the NOAA-16 and NOAA-17 SBUV/2 data are presented in Figure 2. The two systems show similar latitude and height dependence with some notable exceptions. For the layer above 1 hPa, the SBUV/2 retrieval show additional structure in the Northern Hemisphere and do not follow the MLS in a rise up in the Southern Hemisphere. For the 1.0 to 10.0 hPa layer there are latitude-dependent changes in the biases among the three sets of results. The SBUV/2 versus SBUV/2 differences are under investigation. For the 10 to 30 hPa layer the overall agreement is very good. For the lowest layer, 30 to 100 hPa, the two SBUV/2 data sets are in good agreement, but the MLS has higher values at most latitudes. We are continuing these comparisons as new data is obtained and products are adjusted. We will soon begin comparisons with estimates from the recently-launched NOAA-18 SBUV/2.

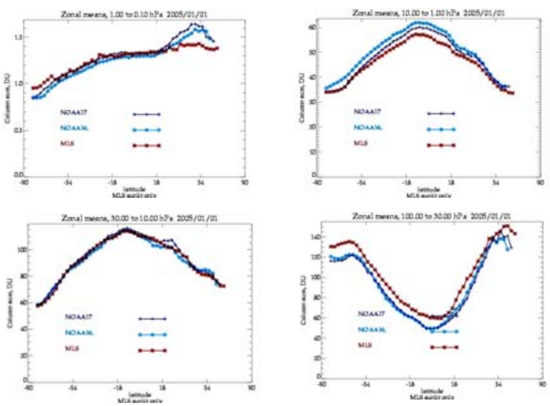
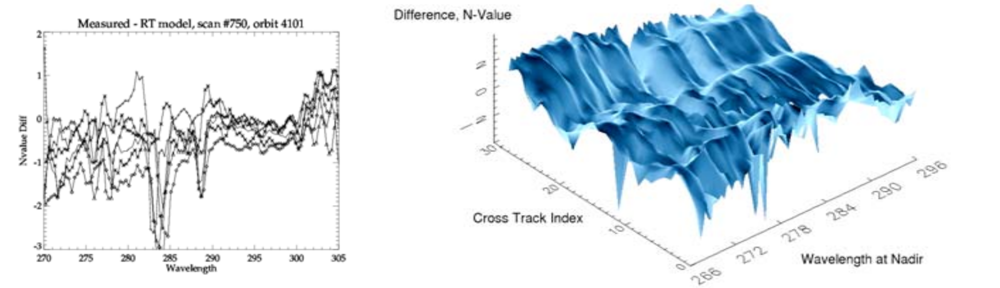


Figure 2. Ozone Profile Layer Comparisons for SBUV/2 and MLS versus Latitude

Forward Model Comparisons

The SBUV/2 ozone retrievals have been used to examine the OMI UV1 radiances. These results are preliminary as the OMI Level 1 products have not been provisionally released. We assume that the stratospheric ozone is reasonable smooth in the daytime in the tropics and located an orbit that had an excellent coincidence with NOAA16-SBUV on April 22, 2005. From roughly 8.5 N to 10 N latitude, there appears to be no major cloud decks, aerosol contamination or sea glint. There is some cloud contamination, but the scenes are mostly clear. We take an averaged V8 SBUV/2 NOAA 16 ozone profile and a nearby MLS temperature profile for input into the TOMRAD radiative transfer code. The geometry of the OMI observations (Satellite Viewing Angles, Solar Azimuth and Zenith Angles) are used as input for TOMRAD. When clouds are present, the independent pixel approximation is used to get a Lambert Equivalent Reflectivity (LER) and the radiances are weighted averages of clear and cloudy model runs. The cloud fraction for UV1 pixel is averaged from the UV2 cloud fraction value as determined by OMTO3. The cloud height information is the V8 climatological value. A very simple bandpass model is used(0.42-nm, triangular, 15 sub-channels), and the slit-averaged top-of-atmosphere radiances are obtained for 30 OMI cross-track positions and 159 UV1 wavelength channels. The solar irradiance used in the slit average is formed from that day's solar by aggregating each L1BIRR pixel in a flat sorted array with an approximate average spacing of 0.01 nm. A 0.1nm boxcar is convoluted to obtain a much smoother version. A smooth solar is used to separate the effects of noise in the irradiance from the radiance. The output of the RT model is a sun normalized radiance field that can be compared to the measured radiance at the same geometry. The measured OMI radiance also is normalized by the smoothed UV1 solar signal. Figures 3 and 4 shows the resulting structure in the difference of the measured and simulated radiance. The figure on the right shows consistent differences for different cross-track positions. This may related to the choice of a solar measurement and goniometric complications. Some smoothing has been done in the surface plotting routine in order to better focus on the larger scale differences rather than outliers. The figure on the left shows slices through the surface for different cross-track positions. The variations near 285 nm may be associated with interactions between the simplified bandpass model and a strong solar feature.



Figures 3 and 4. N-value Differences between OMI UV1 scan #750, orbit 4101 and Forward Model Radiances using SBUV/2 ozone profiles.

Conclusions and Future Work

We are comparing EOS Aura MLS ozone products to our operational profile ozone products from SBUV/2 instruments on NOAA-16, and -17. The results are providing information on areas for further investigation for both systems. We have assessed the consistency of the OMI measurements are believe they have the potential to produce good quality ozone profile products with full global coverage.

We are benefiting from the lessons learned during application of the Version 8 total ozone algorithm to OMI in our work to implement and adapt that algorithm for use with GOME-2 measurements beginning next year. Using the Version 8 SBUV/2 ozone profile retrieval code as a starting point, we are implementing changes so that the profile algorithm can make retrievals for off-nadir satellite view angles using an arbitrary number of channels with channel-dependent slit functions. This algorithm will be demonstrated once OMI Level 1B products are publicly released. A match-up comparison between the 10 hPa estimates from an OMI research ozone profile product and the operational SBUV/2 product for one orbit of data are shown in the figure to the right. The two systems are producing similar estimates of atmospheric variations.